

What is claimed is:

1. An apparatus for robot handling control including:
an object grasping unit;
an external force detecting section for detecting an external force acting upon a grasped object;
a grasped-object external force deducing unit for deducing, in a case the external force has a change value equal to or greater than a predetermined threshold, a factor of the change value of the external force; and
a grasp-force control section for outputting a grasp-force relaxing signal for releasing a grasp force of the object grasping unit or a grasp-force strengthening signal for strengthening a grasp force of the object grasping unit, according to a deduction result.
2. An apparatus for robot handling control according to claim 1, wherein the grasped-object external force deducing unit deduces as a request for releasing the grasped object in a case the external force has a change value equal to or greater than the predetermined threshold, and said gripped-object external force deducing unit further deduces as a non-deliver of the grasped object in a case of detecting a dynamic frictional force in a gravity direction caused by a fall movement of the grasped object after releasing the grasped object from the object grasping unit.
3. An apparatus for robot handling control according to claim 1, wherein the grasped-object external force deducing unit deduces as a deliver of the grasped object in a case the external force has a change value equal to or greater than a predetermined threshold, the object grasping unit is moved in a direction different from a direction in which the external force acts, and the external-force detecting section detects a reactive force.
4. An apparatus for robot handling control according to claim

1, wherein the object grasping unit is an end effector constituting a mechanism for grasping an object, the external-force detecting section is a force sensor for detecting an external force acting upon the grasped object wherein, in a case the grasped-object external force deducing unit deduces as a request for releasing the grasped object, the grasp-force control section outputs a grasp-force releasing signal to the end effector thereby releasing a grasp force of the end effector while, in a case the grasped-object external force deducing unit deduces as a non-delivery of the grasped object, the grasp-force control section outputs a grasp-force strengthening signal for strengthening the grip force to the end effector.

5. An apparatus for robot handling control according to claim 1, wherein the object grasping unit has an end effector constituting a mechanism for grasping an object, a robot arm attached with the end effector and including a plurality of joints, and an arm control section for controlling an operation of the robot arm, wherein, in a case the external force acting upon the end effector has a change value equal to or greater than a predetermined threshold, the arm control section moves the robot arm in a direction different from a direction in which the external force acts while, in a case the external-force detecting section detects a reactive force and the grasp-object external force deducing unit deduces as a deliver of the grasped object, the grasp-force control section outputs a grasp-force releasing signal to the end effector.

6. An apparatus for robot handling control comprising:
a robot arm including a plurality of joints and a joint angle sensor for detecting a rotation angle of the plurality of joints;
an end effector attached on the robot arm and for grasping an object; and
a grasp-force control section for outputting a grasp-force

relaxing signal to the end effector in a case that a release instruction for releasing the object is inputted and further a change occurs in a detected rotation angle of the joint.

7. An apparatus for robot handling control according to claim 6, further including an arm control section for controlling an operation of the robot arm wherein, in a case that a grasp-force releasing signal is inputted to the end effector, the arm control section lowers rigidity at the joint.

8. An apparatus for robot handling control according to claim 7, wherein, in a case of lowering rigidity at the joint, an alarm is issued for calling attention to an outside.

9. An apparatus for robot handling control according to claim 1, wherein, in a case of releasing the grasp force, an alarm is issued for calling attention to an outside.

10. An apparatus for robot handling control according to claim 6, wherein, in a case of releasing the grasp force, an alarm is issued for calling attention to an outside.

11. A method for robot handling control including:

a first step of detecting an external force acting upon a grasped object at an object grasping unit;

a second step of comparing a change value of the external force with a predetermined threshold;

a third step of deducing, in a case that the external force has a change value equal to or greater than the threshold, a factor of the change value of the external force; and

a fourth step of outputting a grasp-force releasing signal for releasing a grasp force of the object grasping unit or a grasp-force strengthening signal for strengthening the grasp force of the object grasping unit, according to a deduction result in the third step.

12. A method for robot handling control according to claim 11, wherein the third step deduces as a request for releasing the grasped object in a case the external force has a change value equal to or greater than the predetermined threshold and as a non-deliver of the grasped object in a case of detecting a dynamic frictional force in a gravity direction caused by a fall movement of the grasped object after releasing the grasped object from the object grasping unit, the fourth step outputting a grasp-force releasing signal for releasing a grasp force of the object grasping unit.

13. A method for robot handling control according to claim 11, wherein, the third step moves the object grasping unit in a direction different from a direction in which the external force acts in a case the external force has a change value equal to or greater than a predetermined threshold, and deduces as a deliver of the grasped object in case that the first step detects a reactive force after moving the object grasping unit, the fourth step outputting a grasp-force strengthening signal for strengthening the grasp force of the object grasping unit.

14. A method for robot handling control comprising:

a first step of detecting an external force acting upon a grasped object by a force sensor set up on an end effector for grasping an object;

a second step of comparing a change value of the external force with a predetermined threshold;

a third step of deducing a factor of the change value of the external force in a case the change value of the external force is equal to or greater than the threshold;

a fourth step of moving the robot arm in a direction different from a direction in which the external force acts in a case the change value of the external force acting upon the end effector

is equal to or greater than the predetermined threshold;

a fifth step of deducing as a deliver of the grasped object in a case the force sensor detects a reactive force after a movement of the robot arm; and

a sixth step of outputting a grasp-force releasing signal to the end effector in a case that a deduction result in the fifth step is a deliver of the grasped object.

15. A method for robot handling control wherein a release instruction for releasing the object is inputted to an end effector for grasping an object which is attached on a robot arm including a plurality of joints and a joint angle sensor for detecting a rotation angle of the plurality of joints, and further, in a case that a change is caused in the rotation angle of the joint, a grasp-force releasing signal is outputted to the end effector.

16. A method for robot handling control according to claim 15, further including a step that, in a case that a grasp-force releasing signal is inputted to the end effector, rigidity at the joint is lowered.

17. A method for robot handling control according to claim 16, further including a step that, in a case that rigidity at the joint lowers, attention is called to an outside.

18. A method for robot handling control according to claim 12, further including a step that, in a case of releasing the grasp force, attention is called to an outside.

19. A method for robot handling control according to claim 14, further including a step that, in a case of releasing the grasp force, attention is called to an outside.